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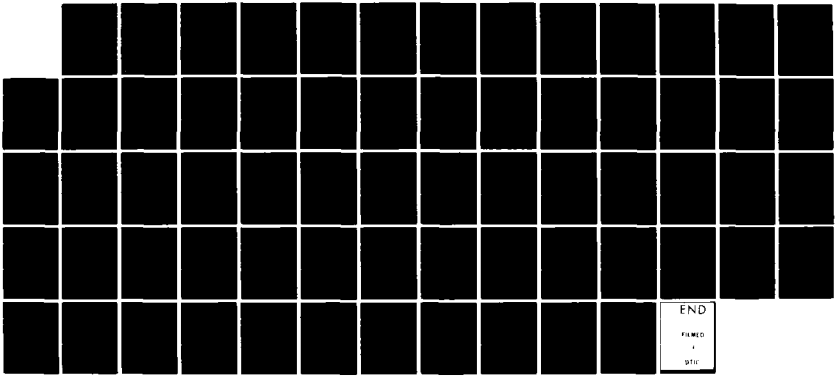

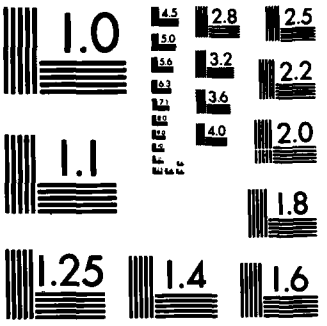


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# VEGETATION IN THE FLOOD PLAIN ADJACENT TO THE MISSISSIPPI RIVER BETWEEN CAIRO, ILLINOIS, AND ST. PAUL, MINNESOTA, AND IN THE FLOOD PLAIN OF THE ILLINOIS RIVER BETWEEN GRAFTON, ILLINOIS, AND CHICAGO, AND THE POSSIBLE IMPACTS THAT WILL RESULT FROM THE CONSTRUCTION OF L & D 26 AND THE ASSOCIATED INCREASE IN BARGE TRAFFIC

By

Robert H. Mohlenbrock
Department of Botany
Southern Illinois University
Carbondale, Illinois

January 20, 1975



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The primary objective of this study has been to describe the major plant communities found in both the protected and unprotected flood-plains in the study area. This included the distribution of each community in the study area, the location of the community relative to soil moisture and frequency of inundation, the dominant woody species in each community, the characteristic shrubs occurring in the mid-layer, and the major herbaceous plants in the understory. For each community, the investigator has surmised what the possible effects might be as a

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result of the construction and operation of Locks and Dam #26 (Replacement) and the increased barge traffic which may occur.

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## Introduction

The St. Louis District, United States Army Corps of Engineers, is desiring to obtain information concerning the plant communities which occur in the floodplain of the Mississippi River from Cairo, Illinois, to St. Paul, Minnesota, and in the floodplain of the Illinois River from Grafton, Illinois, to Chicago. A survey of existing literature and the investigator's twenty-five years' experience studying much of this area have provided data for this study.

The primary objective of this study has been to describe the major plant communities found in both the protected and unprotected floodplains in the study area. This included the distribution of each community in the study area, the location of the community relative to soil moisture and frequency of inundation, the dominant woody species in each community, the characteristic shrubs occurring in the mid-layer, and the major herbaceous plants in the understory. For each community, the investigator has surmised what the possible effects might be as a result of the construction and operation of Locks and Dam #26 (Replacement) and the increased barge traffic which may occur.

Another objective has been to evaluate the possible impact of increased barge traffic on dredge spoil disposal, air pollution, building up and wearing down of sandbars, wave wash, higher or lower water levels in pools, interruption of food chains, indirect impacts associated with secondary impacts, and increased chances for accidents.

Another objective has been to recommend further studies that would be desirable to evaluate the impacts of L & D 26 (Replacement) on vegetation.

Finally, an extensive bibliography dealing with the floodplain and its vegetation is appended to this report.

## Willow Community

The Willow Community occurs along the entire length of the Mississippi River from Cairo, Illinois, to St. Paul, Minnesota, and along the Illinois River from Grafton to Chicago. It is usually the first woodland community to develop on newly formed land. It quickly establishes itself on the developing ends of growing islands.

In addition to growing on islands, this community is frequent adjacent to the Mississippi River and the Illinois River. This community also occurs frequently as a narrow strip of vegetation along the banks of streams tributary to the major rivers and along sloughs.

The soil in which the Willow Community develops is usually very sandy. Because of the proximity of this community to rivers and streams, it is subject to frequent flooding, often annually. Throughout the entire area covered by this report, the Willow Community has a most uniform composition.

The dominant trees in this community are three species of willow--black willow (Salix nigra), sandbar willow (S. interior), and stiff willow (S. rigida). Other trees which occur in the willow community in varying degrees of abundance are cottonwood (Populus deltoides), silver maple (Acer saccharinum), box elder (Acer negundo), and green ash (Fraxinus lanceolata).

There is a rather sparse shrub layer in the willow community, with only buttonbush (Cephalanthus occidentalis) and swamp privet (Forestiera acuminata) occurring with any regularity.

Several vines occur in this community. Along the Mississippi River north of St. Louis, the vines grow in greater abundance and frequently cause dense entanglements. South of St. Louis, fewer vines are found. The principal vines are several species of wild grape (Vitis cinerea, V. aestivalis, V. vulpina), trumpet creeper (Campsis radicans), and poison ivy (Rhus radicans).

There is a paucity of herbaceous species in the Willow Community, undoubtedly due to frequency of inundations. Those herbaceous plants which occur most frequently are frog-fruit (Lippia lanceolata), arrowhead (Sagittaria latifolia), lizard's-tail (Saururus cernuus), several species of milk spurge (Chamaesyce spp.), several species of smartweed (particularly Polygonum persicaria, P. lapathifolium, and P. hydropiperoides), and several species of sedge (Cyperus esculentus, C. strigosus, and C. erythrorhizos).

During the first few years after the establishment of the Willow Community on newly formed land, seedlings of willows, cottonwood, box elder, sycamore (Platanus occidentalis), American elm (Ulmus americana), and slippery elm (Ulmus rubra) begin to appear. The frequency of flooding in this community seems to deter seedling growth of all but the willows so that a cycle of several wet years tends to perpetuate the Willow Community. Conversely, during a cycle of several years with limited flooding, seedlings of cottonwood, box elder, and sycamore become firmly established. Should the frequency of inundation remain low, a Willow-Cottonwood Community generally develops.

Because of the close proximity of the Willow Community to the Mississippi and Illinois Rivers, this will be the most severely affected

forest community should there be an increase in wave action or a higher water level in the pools.

Increased wave action will probably diminish the number of herbaceous species in the community, particularly those such as the milk spurges with shallow root systems. Increased wave action may also prove to be a deterrent to the development of tree seedlings, particularly sycamore, American elm, and red elm. The willow seedlings seemingly are best adapted to increased wave action and will probably survive better than the seedlings of other tree species.

Increased construction along the river will reduce the number of Willow Communities through destruction of the habitat.

Summary: The Willow Community is one of the most common forest communities along the Mississippi and Illinois Rivers. Its species content is remarkably uniform throughout the entire study area. Because of its close proximity to the rivers, this community will probably be the most affected forest community, if there is increased wave action or a higher water level in the pools. This community has very few rare species of vascular plants in it.

## Willow-Cottonwood Community

The Willow-Cottonwood Community is common along the Mississippi and Illinois Rivers in the area covered by this study. It occasionally is the forest type nearest to the river, but often it is separated from the river by the Willow Community. Throughout the study area, the composition of this community is fairly uniform.

The Willow-Cottonwood Community also may be found along many of the tributaries in both the protected and unprotected floodplain. In its moisture requirements and soil composition, this community is somewhat intermediate between the Willow Community and the Silver Maple-Cottonwood or Silver Maple-Cottonwood-Pin Oak communities.

The subsoils in the Willow-Cottonwood Community are usually coarse, and the soil is usually quite wet throughout the growing season.

Cottonwood (Populus deltoides) and black willow (Salix nigra) are the dominant trees in this community. Other important trees present in varying degrees of abundance are silver maple (Acer saccharinum), American elm (Ulmus americana), slippery elm (U. rubra), box elder (Acer negundo), sycamore (Platanus occidentalis), green ash (Fraxinus lanceolata), and pecan (Carya illinoensis). In the southernmost region of the study area (i.e., Alexander and Union counties, Illinois), swamp cottonwood is a frequently encountered species in the Willow-Cottonwood Community. Sand-bar willow (Salix interior) is common in some communities of this type but virtually absent in others.

The Willow-Cottonwood Community usually is initiated with the seeding of cottonwood or willow or both (Hosner & Minckler, 1963). The more

moist substrate seems to favor the initial seeding of willow (Yeager, 1949; Hall & Smith, 1955). If inundation of the area occurs during the first year of seedling growth, often only the black willow will survive (Hosner, 1960).

As long as prolonged inundation of the community does not occur, the community will develop into the Willow-Cottonwood stage described above. Hackberry (Celtis occidentalis) ultimately comes in and, after several years when the area is free from prolonged inundation, various species of oak may appear.

The shrub layer in this community is composed of swamp privet (Forestiera acuminata), low dogwood (Cornus foemina) and, in wetter areas, buttonbush (Cephalanthus occidentalis). Woody vines include wild grapes (Vitis cinerea and V. aestivalis), poison ivy and, in the southern half of the study area, trumpet creeper (Campsis radicans).

Herbaceous plants are more abundant in the Willow-Cottonwood Community than in the Willow Community because of the lesser amount of flooding. Smartweeds (Polygonum spp.), stinging nettle (Laportea canadensis), lizard's-tail (Saururus cernuus), species of beggar's-lice (Bidens spp.), and clearweed (Pilea pumila) are usually common.

Construction and operation of Locks and Dam No. 26 (Replacement) and the resultant projected increase in barge traffic will affect this community only where the Willow-Cottonwood Community is within close proximity to the major rivers.

Increased wave action will probably reduce the number of herbaceous plants in the community. It may also prolong the willow stage in

the early development of this community by destroying all other tree seedlings.

Construction along the river will result in the destruction of this community wherever the construction occurs.

Summary: The Willow-Cottonwood Community is found along the Mississippi and Illinois Rivers throughout the study area. Wherever it occurs, the species of this community are fairly uniform, with cottonwood and black willow being the dominant trees. Increased wave action due to greater barge traffic will probably reduce the number of herbaceous plants in the community. Development of new construction areas will also destroy this community.

## Silver Maple-Cottonwood Community

The Silver Maple-Cottonwood Community occurs along the Mississippi and Illinois Rivers for the length of the study area. It perhaps covers more acreage than any of the other forested communities.

This community sometimes is found along the edge of the rivers, but usually it is separated from the river by the Willow Community and/or the Willow-Cottonwood Community. It also occurs along tributaries to the major rivers in both the protected and unprotected floodplain.

The soil in this community is sandy to silty (Klein, et al., 1974), and much debris which is usually found on the forest floor is an indicator of frequent flooding.

Silver maple (Acer saccharinum) and cottonwood (Populus deltoides) are the dominant trees in this community, often forming up to 75% and 25%, respectively, of the tree composition (Klein, et al., 1974). The canopy formed by these species is open enough that light penetrating to the forest floor is sufficient to permit the growth of several other species, both woody and herbaceous.

Trees of secondary importance in this community are American elm (Ulmus americana), slippery elm (U. rubra), black willow (Salix nigra), green ash (Fraxinus lanceolata), pecan (Carya illinoensis), box elder (Acer negundo), and red mulberry (Morus rubra).

Shrubs occurring in the Silver Maple-Cottonwood Community are swamp privet (Forestiera acuminata), gray dogwood (Cornus obliqua), and various species of hawthorn (Crataegus spp.).

Several vines, some of which form dense entanglements, grow in the Silver Maple-Cottonwood Community. Among these are catbriers (Smilax glauca, S. rotundifolia, and S. hispida), trumpet creeper (Campsis radi-

cans), poison ivy (Rhus radicans), and Virginia creeper (Parthenocissus quinquefolius).

Common herbaceous plants in this community throughout the entire range of the study area include false stinging nettle (Laportea canadensis), lizard's tail (Saururus cernuus), arrowhead (Sagittaria latifolia), smartweeds (Polygonum pennsylvanicum, P. lapathifolium, P. persicaria), and several species of asters (Aster spp.) and sedges (Cyperus spp. and Carex spp.). Wood reed grass (Cinna arundinacea) is sometimes common.

Increased barge traffic which results in greater wave action will have deleterious effects on the Silver Maple-Cottonwood Community only when this community is close enough to the river to receive direct wave action. When this situation prevails, several of the herbaceous species may be washed from this community. Solidly rooted herbs, however, will probably withstand increased wave action.

Where higher pool levels would cause inundation of this community, damage likely would be done to most species present except possibly black willow.

Increased construction along the rivers will destroy this community if it occurs where the construction takes place.

Summary: The Silver Maple-Cottonwood Community occurs along the entire length of the Mississippi and Illinois Rivers. Silver maple and cottonwood are the dominant trees in this community. Where this community occurs in close proximity to the rivers, there may be some loss of herbaceous species were barge traffic to increase substantially. An increase in level of the pools probably would have deleterious effects on this community.

## Silver Maple-Cottonwood-Pin Oak Community

The Silver Maple-Cottonwood-Pin Oak Community is intermediate between the more mesic Silver Maple-Cottonwood Community and the less mesic Pin Oak Community.

This community occurs sporadically along the length of the Mississippi River covered by this study, but is less frequently found along the Illinois River. The soils range from sandy to silty. The forest floor often has considerable debris on it, indicating some annual flooding.

Species composition is similar to that found in the Pin Oak Community, with a greater diversity of species than is present in the Silver Maple-Cottonwood Community.

The dominant trees in the Silver Maple-Cottonwood-Pin Oak Community are silver maple (Acer saccharinum) and pin oak (Quercus palustris). Although cottonwood (Populus deltoides) is usually present and sometimes plentiful, it is clearly subdominant in this community. Several other trees are found regularly in this community. The more common of these are green ash (Fraxinus lanceolata), hackberry (Celtis occidentalis), sugarberry (Celtis laevigata), black willow (Salix nigra), sycamore (Platanus occidentalis), box elder (Acer negundo), and red mulberry (Morus rubra).

A greater variety of shrubs and small trees is found in this community than in the more mesic communities. Rough-leaved dogwood (Cornus drummondii), swamp holly (Ilex decidua), and hawthorns (Crataegus spp.)

are generally the most common members of the shrub and small tree stratum. Swamp privet (Forestiera acuminata), which is prevalent in the Silver Maple-Cottonwood Community, is much less common or even absent in this community.

Vines form dense undergrowth, with wild grapes (Vitis cinerea, V. vulpina, V. aestivalis), catbriers (Smilax glauca, S. rotundifolia, S. hispida), poison ivy (Rhus radicans), Virginia creeper (Parthenocissus quinquefolia), and trumpet creeper (Campsis radicans) the most abundant ones.

The canopy is a little more closed in this community than in the Silver Maple-Cottonwood Community with the result that fewer herbaceous plants receive enough sunlight to persist. Some common species, such as lizard's tail (Saururus cernuus), smartweeds (Polygonum spp.), and false stinging nettle (Laportea canadensis) are here, but in less abundance, generally, than in the Silver Maple-Cottonwood Community.

The Silver Maple-Cottonwood-Pin Oak Community almost never occurs immediately adjacent to the large rivers, but is separated from them by the Willow Community, the Willow-Cottonwood Community, and/or the Silver Maple-Cottonwood Community. Because of this, the Silver Maple-Cottonwood-Pin Oak Community should be little affected by increased barge traffic in the rivers. Only construction sites would pose a threat to this community.

Summary: The Silver Maple-Cottonwood-Pin Oak Community occurs occasionally in the floodplain of the Mississippi River, but is much less

common along the Illinois River. This community is dominated by silver maple and pin oak, although many other species of trees grow here as well. Because this community generally does not occur directly adjacent to the river, little damage to it is anticipated with respect to increased wave action.

## Pin Oak Community

The Pin Oak Community occurs in the floodplain all along the Mississippi River from Cairo to St. Paul, but is much more common from St. Louis southward. It is less abundant along the Illinois River, perhaps due to extensive logging (Klein, et al., 1974). Almost all communities of this kind occur in the protected floodplain.

Although pin oak (Quercus palustris) is dominant in this community, many other tree species are associated with it. Among the more common ones are silver maple (Acer saccharinum), slippery elm (Ulmus rubra), American elm (U. americana), green ash (Fraxinus lanceolata), pecan (Carya illinoensis), sugarberry (Celtis laevigata), and red mulberry (Morus rubra). Also characteristic of this community, but usually not abundant, are bur oak (Quercus macrocarpa), hackberry (Celtis occidentalis), cottonwood (Populus deltoides), and black willow (Salix nigra).

The shrub and small tree stratum is much the same in this community as in the Silver Maple-Cottonwood-Pin Oak Community, with the most common shrubs being rough-leaf dogwood (Cornus drummondii) and swamp holly (Ilex decidua).

Many vines form entanglements in the understory of the Pin Oak Community. Poison ivy (Rhus radicans) and Virginia creeper (Parthenocissus quinquefolia) are common, and catbriers (Smilax spp.) and wild grapes (Vitis spp.) occur in most communities of this kind.

There is a good diversity of herbaceous species in the Pin Oak Community, although the per cent of ground covered is still less than

25% (Klein, et al., 1974). Lizard's tail (Saururus cernuus) occurs in the wetter areas of this community, while in less moist regions, species of beggar's-lice (Bidens spp.), asters (Aster spp.), and smartweeds (Polygonum spp.) occur. Unlike the Silver Maple-Cottonwood Community, there is little debris on the forest floor, indicating a much lesser degree of flooding.

Because the Pin Oak Community is usually found in the protected floodplain, little consequence is seen due to increased barge traffic on the rivers.

Summary: Although the Pin Oak Community occurs along both rivers throughout the study area, it is more abundant in the region between St. Louis and Cairo. Pin oak is the dominant woody species in this community. Since the Pin Oak Community is primarily in the protected floodplain, there should be very little damaging effects to it because of increased barge traffic or higher pool levels.

## Pin Oak-Silver Maple-Sweet Gum Community

The Pin Oak-Silver Maple-Sweet Gum Community is confined to the floodplain of the Mississippi River south of St. Louis. It is somewhat similar in species composition to the Pin Oak Community, but differs in the usual abundance of sweet gum (Liquidambar styraciflua), and the greater numbers of oaks (Quercus spp.) and hickories (Carya spp.). This community clearly is a successional stage leading to an oak-hickory subclimax forest.

Much of this type of community is found in the protected floodplain, although in Alexander and Union counties, it sometimes occurs in the unprotected floodplain and is subject to annual inundations.

This community is dominated by pin oak (Quercus palustris) and silver maple (Acer saccharinum), with American elm (Ulmus americana) and sweet gum usually serving as subdominants. Other trees occurring regularly are species of hickory (Carya spp.), oaks (Quercus spp.), ashes (Fraxinus spp.), pecan (Carya illinoensis), hackberry (Celtis occidentalis), and sugarberry (Celtis laevigata).

Hosner and Minckler (1963) report that reproduction 1-5 years old in this community consists mostly of American elm, pin oak, hickories, ashes, maples, hackberry, box elder (Acer negundo), and sweet gum. In older stands of this community, there is an increasing number of oaks and hickories.

The shrub layer in the Pin Oak-Silver Maple-Sweet Gum Community is composed of dogwoods (Cornus obliqua, C. foemina), hawthorns (Crataegus

spp.), swamp holly (Ilex decidua), and others.

Wild grapes (Vitis spp.), poison ivy (Rhus radicans), snailseed (Cocculus carolinus), and moonseed (Menispermum canadense) are among the more common vines in this community.

Herbs are rather plentiful in the Pin Oak-Silver Maple-Sweet Gum Community. False stinging nettle (Laportea canadensis) is locally common. Several species of sedges are characteristic of this community, including Carex grayii, C. lupulina, C. frankii, and others. Wood reed grass (Cinna arundinacea) is a common species in this community.

Where this community occurs in the protected floodplain, no deleterious effects are expected with regard to increased barge traffic along the Mississippi River. In the unprotected floodplain, increased wave wash conceivably could reduce the herbaceous layer and possibly prevent new areas of this community from developing.

Summary: The Pin Oak-Silver Maple-Sweet Gum Community is found mostly in the protected floodplain of the Mississippi River south of St. Louis. As a result, it should experience little change because of an increase in barge traffic.

## Terrace Oak-Hickory Community

The Terrace Oak-Hickory Community is found on Pleistocene river terraces above the junction of the Illinois River with the Mississippi. It is different from the sub-climax oak-hickory communities found in more upland situations in the midwest.

The soil, because of its past geological history, is sandy and well-drained. The vegetation forms a relatively dense canopy. Many species comprise the overstory in this community, with two species of hickories and six species of oaks being co-dominants (Klein, et al., 1974).

Shagbark hickory (Carya ovata) is the most important species in the Terrace Oak-Hickory Community, comprising from 5-50% of the total cover (Klein, et al., 1974). King-nut hickory (Carya laciniosa), shingle oak (Quercus imbricaria), swamp white oak (Q. bicolor), pin oak (Q. palustris), post oak (Q. stellata), northern red oak (Q. rubra), and yellow chestnut oak (Q. muhlenbergii) are co-dominant with shagbark hickory.

In addition to the oaks and hickories in the Terrace Oak-Hickory Community are several other trees, including slippery elm (Ulmus rubra), black walnut (Juglans nigra), and wild black cherry (Prunus serotina).

Shrubs in the Terrace Oak-Hickory Community are represented by swamp holly (Ilex decidua) and species of hawthorn (Crataegus spp.).

Vines are plentiful in this community, although usually not as abundant as in the Pin Oak Community.

The herbaceous stratum in the Terrace Oak-Hickory Community is composed primarily of mesic woodland species, such as touch-me-not (Impatiens

spp.), mayapple (Podophyllum peltatum), violets (Viola spp.), and yellow corydalis (Corydalis flavula).

Because the location of the Terrace Oak-Hickory Community in the Pleistocene river terraces is usually at a great enough distance from the major rivers not to be jeopardized by increased barge traffic, threats from possible construction sites are possible. Since the Terrace Oak-Hickory Community is unique, efforts should be made to conserve it wherever it occurs.

Summary: The Terrace Oak-Hickory Community is found only on Pleistocene river terraces, mostly above the junction of the Illinois and Mississippi Rivers. Shagbark hickory is the dominant woody species, but one other hickory and six species of oak are characteristic. Although this community, because of its distance from the river, will probably be little affected by increased wave action, it should be protected from any potential source of damage because of its unique nature.

## Flatwoods Oak Community

The Flatwoods Oak Community is restricted to the floodplain of the Mississippi River in Jackson, Union, and Alexander counties, Illinois. For the most part, it is in the protected floodplain.

The topography is extremely flat, with shallow depressions containing standing water throughout a good portion of each year.

The trees in the Flatwoods Oak Community grow tall and straight and usually close together, forming a rather dense canopy. Several species of oaks serve as co-dominants in this community. Most common are pin oak (Quercus palustris), overcup oak (Q. lyrata), bur oak (Q. macrocarpa), and swamp chestnut oak (Q. michauxii). Other trees commonly occurring in this community are red maple (Acer rubrum), honey locust (Gleditsia triacanthos), and king-nut hickory (Carya laciniosa). American elm (Ulmus americana) is sometimes abundant, particularly if the canopy is very closed.

The shrub layer in this community is well-developed. Swamp holly (Ilex decidua), swamp rose (Rosa palustris), and several species of hawthorn (Crataegus spp.), including two very rare ones for Illinois (Crataegus collina and C. marshallii), are the chief species in the shrub stratum.

The herbaceous plants usually form a dense growth covering up to 90% of the forest floor. A large number of species makes up the herbaceous layer, with several of them rare for Illinois. Most abundant among the herbs are false nettle (Boehmeria cylindrica), swamp milkweed (Asclepias incarnata), spotted touch-me-not (Impatiens biflora), pale touch-

me-no: (I. pallida), beggar's-lice (Bidens spp.), sedges (particularly Carex muskingumensis), and grass (particularly Glyceria septentrionalis).

A different flora exists in the shallow pools of standing water. Slender buttercup (Ranunculus pusillus), leucospora (Leucospora multifida), and brookweed (Samolus parviflorus) occur around the edge of the pools, while several species of duckweeds (Spirodela spp. and Lemna spp.) and water starwort (Callitriche heterophylla) grow in the water.

This community is perhaps successional to the Wooded Swamp Community. Hosner and Minckler (1963) report that if surface drainage becomes improved in the Flatwoods Community, usually cherrybark oak (Quercus pagodaefolia), sweet gum (Liquidambar styraciflua), American elm, and river birch (Betula nigra) come in.

Because of its usual occurrence in the protected floodplain, this community is in no danger from increased barge traffic on the Mississippi River.

Summary: The Flatwoods Oak Community is found only in the Mississippi River floodplain south of Chester, Illinois. It is principally located in the protected floodplain. A large variety of species comprise this community. It should be in little danger should there be an increase in barge traffic on the river.

## Wooded Swamp Community

The Wooded Swamp Community develops in poorly drained bottomland areas, usually in the protected floodplain. Although wooded swamps occur along most of the length of the Mississippi River, the ones of better quality are in the floodplain south of St. Louis.

The alluvium in this community consists of finer-textured particles, generally forming heavy, waxy, clay soils (Hosner and Minckler, 1963). The wet areas are gradually filled in by erosion sediments, slowly decreasing the maximum depths of standing water. Tree reproduction occurs chiefly during relatively dry seasons.

The trees of this community are diverse, with the species composition dependent in part on the depth and duration of the standing water. In areas of deeper water and prolonged inundation in southern Illinois, bald cypress (Taxodium distichum) and tupelo gum (Nyssa aquatica) are the dominant species, with swamp cottonwood (Populus heterophylla), pumpkin ash (Fraxinus tomentosa), and Drummond's red maple (Acer rubrum var. drummondii) serving as sub-dominants. Other species occurring in moderate abundance are honey locust (Gleditsia triacanthos) and black willow (Salix nigra).

Southern swamp species such as bald cypress, tupelo gum, and pumpkin ash drop out in the central and northern floodplains along the Mississippi River. In these more northern wooded swamps, green ash, honey locust, and black willow dominate.

Shrubs vary with the latitude, as well. Buttonbush (Cephalanthus occidentalis) occurs along much of the Mississippi River, but swamp rose

(Rosa palustris) and Virginia willow (Itea virginica) are restricted to the southernmost region.

The herbaceous species also vary with the latitude. In the wooded swamps of Alexander and Union counties, Illinois, many of the herbaceous species are ones typically found in the Coastal Plain. Several of these are rare, including sponge plant (Limnobium spongia), red iris (Iris fulva), Arkansas manna grass (Glyceria arkansana), and Puccinellia pallida. Other species, such as bladderwort (Utricularia gibba), water crowfoot (Ranunculus flabellaris), and water plantain (Alisma plantago-aquatica) occur in both the northern and southern floodplains of the Mississippi River.

Since most of the wooded swamps are in the protected floodplain, there should be little effect upon them due to increased barge traffic along the Mississippi River. However, because of the high number of unusual Coastal Plain species in the wooded swamps, protection should be afforded them regardless of the source of any threat to them.

Summary: The Wooded Swamp Community usually occurs in the protected floodplain of the Mississippi River, primarily in poorly drained bottomland areas. The diversity of species in this community should be little affected by increased barge traffic or any increase in the pool levels.

## Black-jack Oak Sand Forest Community

The Black-jack Oak Sand Forest Community develops successional to the sand prairies. They occur principally in the Illinois River floodplain in Mason, Tazewell, Cass, and Morgan counties.

This community is limited entirely to sand, never encroaching upon the bottomland forests adjacent to the Illinois River some thirty to fifty feet below.

Black-jack Oak (Quercus marilandica) comprises up to 50% of this community, with black oak (Q. velutina) and false shagbark hickory (Carya ovalis) accounting for the remaining tree composition. Beneath these three species are occasional clumps of the shrubby aromatic sumac (Rhus aromatica), lead plant (Amorpha canescens), and prairie willow (Salix humilis).

Some bunch grasses persist on the forest floor, particularly fall witch grass (Leptoloma cognatum), sand lovegrass (Eragrostis trichodes), and big blue-stem (Andropogon gerardii).

Many of the common herbs in the Black-jack Oak Sand Forest Community are also in the Sand Prairies. Included among these are rose mallow (Callirhoe triangulata), prickly pear cactus (Opuntia rafinesquii), sessile-leaved beggar's-ticks (Desmodium sessilifolia), froelichia (Froelichia campestris), and frostweed (Helianthemum bicknellii).

There are other herbs, however, which apparently are restricted to the Black-jack Oak Sand Forest Community. These include several species of beggar's-ticks (Desmodium nudiflorum and D. paniculatum), small partridge pea (Cassia nictitans), pin weed (Lechea villosa), St. John's-wort (Hypericum sphaerocarpum), and many others.

Since this community is elevated several feet above the Illinois River, it is not likely to be threatened by increased barge traffic on the river. Nonetheless, because of the unique nature of the Black-jack Oak Sand Forest Community, it should be protected from any element which may threaten its existence.

Summary: The Black-jack Oak Sand Prairie Community is a unique community which develops successionally from the sand prairies along the Illinois River. It is dominated by black-jack oak, black oak, and false shagbark hickory. Located generally thirty to fifty feet above the Illinois River, it probably will not be subjected to any adversities due to increased barge traffic in the river.

## Sand Bar Community

Sand bars are common along the entire length of the Mississippi and Illinois Rivers. They vary in size and shape and in degree of permanency. Some sand bars are permanent and are known to have been in existence for many years. Others may be only temporary, caused primarily by dredging operations. These are mainly in the river channels.

Most sand bars, at one time or another, have driftwood and other river debris strewn over them. They are subject to frequent inundations, although they are usually situated at a slightly higher elevation than the mud flats.

The vegetation of the sand bars, of necessity, must be water-tolerant and fast-growing. In general, the species composition of the sand bars is less diverse than that of the sand and mud flats.

Sandbar willow (Salix interior) is present on many of the sand bars where it attains its maximum size. Black willow (Salix nigra) and cottonwood (Populus deltoides) are often on the sand bars, but usually in lesser numbers. Seedlings of silver maple (Acer saccharinum), box elder (Acer negundo), and sycamore (Platanus occidentalis) often develop on sand bars, but frequent inundations usually keep them from developing into trees. An exception to this is on sand bars which are elevated so that inundation is less frequent. On these sand bars, small saplings can sometimes be found.

A few coarse herbs are found on sand bars. Most common of these are false nettle (Boehmeria cylindrica), stinging nettle (Laportea canadensis), asters (Aster spp.), beggar's-lice (Bidens spp.), and poison ivy (Rhus radicans).

Increased wave action resulting from increased barge traffic will probably cause washing-away of some of the sand bar and its herbaceous vegetation. Fortunately, nearly all of the herbaceous plants of sand bars are ubiquitous species.

Raising of the pool levels could permanently inundate some of the lower-level sand bars, resulting in the killing of all vegetation on the bars. Were this to occur, new sand bars at higher elevations would probably develop with most or all of the same species of plants.

Summary: Sand bars are found along the total length of the Mississippi and Illinois Rivers. Species composition on the sand bars is generally less diverse than that on the sand and mud flats. Washing away of some of the herbaceous plants on the sand bars is likely if there is increased wave action due to increased barge traffic on the rivers.

## Sand and Mud Flat Community

Sand and mud flats are newly formed land or land uncovered by the recession of water (Terpening, et al., 1973).

Because of the proximity of these flats to the river, they are subjected to frequent inundations, although these floodings apparently do not alter the species composition of the flats.

The vegetation is diverse on the sand and mud flats. Evans (1971), who studied several of these flats in Jackson County, Illinois, recorded more than 200 species of vascular plants. Of these, about 40 per cent were non-native members of the flora.

Seedlings of sandbar willow (Salix interior), black willow (S. nigra), and cottonwood (Populus deltoides) sometimes develop on the flats. If conditions are optimum for their development, the Willow Community becomes established.

Herbaceous plants make up the bulk of the vegetation on the sand and mud flats. Many grasses are common, including slender lovegrass (Eragrostis pectinacea), pony grass (E. hypnoides), feather grass (Leptochloa filiformis), and thread-stemmed panic grass (Panicum capillare). Sedges are also numerous, with several species of Cyperus (C. rivularis C. erythrorhizos, C. aristatus, C. ferruginescens, C. strigosus) and Scirpus micranthus being the most prevalent.

Carpetweed (Mollugo verticillata), yellow cress (Rorippa sessiliflora), and several species of spurge (Chamaesyce spp.) and cinquefoil (Potentilla spp.) occur on sand and mud flats throughout the entire area covered by this study.

Increased wave action will wash away many of the shallow-rooted herbaceous plants, but most of them will probably re-seed and germinate when conditions are once again favorable. Greater wave action may also deter the Willow Community from becoming established.

Summary: The Sand and Mud Flat Community develops on newly formed land. It is primarily a community of herbaceous vegetation, although seedlings of sandbar willow, black willow, and cottonwood may abound. The flats are subject to frequent inundations, and increased wave action will probably wash away many of the shallow rooted herbs. Most of these herbs can probably re-establish themselves on other newly formed flats.

## Sand Prairie Communities

Sand prairies occur sporadically along both the Mississippi and Illinois Rivers, but are particularly concentrated in Cass, Morgan, Tazewell, and Mason counties along the Illinois River, and in Carroll and Whiteside counties along the Mississippi River.

The sand prairies are generally dry. At some of them, there is a tendency toward dune formation, frequently with sand blowouts. These dunes may become as tall as sixty feet.

The surface sands along the Illinois River, subjected to wind action, have drifted into irregular, undulating dunes. These dunes often form long ridges parallel to the valleys (Hart & Gleason, 1907).

The sand in these areas, particularly in the blowouts, is so loose that only a limited number of plants can grow in it. The sand blown by the wind often is deposited in a fan-shaped mound. In order to keep from being blown from the sand, most of the psammophilous species are adapted as sand-binders (Hart & Gleason, 1907).

The sand prairies support three distinct types of vegetational communities--the bunch-grass association, the blow-sand association, and the blowout association.

The bunch-grass association is the most commonly encountered sand prairie community. It is characterized, as the name implies, by clumps of grasses up to two feet in diameter. Principal grasses in this association are fall witch grass (Leptoloma cognatum), sand love grass (Eragrostis trichodes), and needle grass (Stipa spartea). Several other grasses are common, including Eragrostis pectinacea, Bouteloua hirsuta,

Panicum virgatum, and sand three-awn (Aristida tuberculosa). Sedges are also prominent, and some of them tend to become bunch-forming. Among these are Cyperus filiculmis, C. schweinitzii, and Carex gravida. Other plants representative of this community are lead plant (Amorpha canescens), rose mallow (Callirhoea triangulata), dotted bergamot (Monarda punctata), and prickly pear cactus (Opuntia rafinesquii).

Whenever considerable bodies of sand occur, the wind plays a prominent part in determining the physiography, causing migrating dunes and blowouts (Hart & Gleason, 1907). Blowouts develop rapidly when the protective covering of vegetation is broken, frequently due to cultivation practices. Where the blowouts are refilled by sand, thus transforming the blowouts back to level land, the sand is called blowsand. On this blowsand develops a characteristic community made up of Polanisia jamesii, winged pigweed (Cycloloma atriplicifolia), Aristida tuberculosa, sand bur (Cenchrus longispinus), and partridge pea (Cassia fasciculata).

When the blowouts are excavated to their maximum depth, the blowout community develops at the bottom (Hart & Gleason, 1907). The new blowout is first covered by thread sedge (Bulbostylis capillaris). Following this come Panicum virgatum, Stipa avenacea, and big blue-stem (Andropogon gerardii). Later, such prairie species as blazing-star (Liatris scariosa), hawkweed (Hieracium longipilum), Indian plantain (Cacalia atriplicifolia), beggar's-ticks (Desmodium canadensis), and species of sunflowers (Helianthus spp.) occur in the blowouts.

It is in the sand prairies that some of the rarest species of the United States occur. The most unusual of these are bladderpod (Lesquerella

ludoviciana), sedge (Cyperus grayioides) yellow aster (Hymenoxys herbacea), and rice grass (Oryzopsis pungens), although several other uncommon species occur here as well.

These sand prairies occur on the glacial floodplains, or "second bottoms," about thirty to fifty feet above the Illinois River. Because of their elevation, they will probably not be affected by increased wave action or increased water level in the pools, but their very rare occurrence in the midwest makes it imperative that they be protected.

Summary: Sand Prairie Communities occur principally along the Illinois River in Cass, Morgan, Tazewell, and Mason counties, and along the Mississippi River in Whiteside and Carroll counties, Illinois. These communities can be divided into three basic types--bunch-grass, blowsand, and blowouts. Many very rare species of vascular plants occur in these areas. Because the prairies are generally thirty to fifty feet above the rivers, they are not in immediate danger of increased wave action or pool levels. Nonetheless, utmost care should be taken to preserve these communities.

## Limestone Cliff Community

There are, along the course of the Mississippi River, occasional areas where limestone cliffs occur at the water's edge. Although most of the cliff face is well above the water line of the river, even in times of flooding, the lower few feet are subject to wave wash and fluctuating water changes.

The species which occur toward the base of the cliffs are primarily those which normally are associated with limestone areas rather than with floodplains.

Any rise in water level of the river which is permanent would destroy whatever species would become submerged.

Each limestone cliff adjacent to the river has its own particular flora so that a general characterization of the species composition is not possible. For example, the cliff flora of Devil's Bake Oven at Grand Tower, Illinois, is considerably different from the cliff flora in the vicinity of the Jefferson Barracks Bridge in St. Louis County, Missouri.

While plants growing near the base of these cliffs will be destroyed by any permanent rise in the water level, all of the species which would probably be affected occur elsewhere along the cliffs of the Mississippi River.

Summary: Limestone cliffs occasionally occur at the edge of the Mississippi River. Where increased water level in the river will permanently submerge plants growing at the base of the cliffs, these plants will perish. None of these plants is restricted to the base of these cliffs, however.

## Lakes and Ponds Communities

Under this heading will be described all communities associated with lakes and ponds, regardless of the origin of these bodies of water. This will include both natural and artificial impoundments, including oxbow lakes.

Oxbow lakes, formed by rechanneling of the rivers, are found mostly in the extreme southern region of the study area, particularly in Alexander and Union counties, Illinois. The oxbow lakes in these southern counties have a distinct Coastal Plain element in their flora. The shallower parts of these oxbows support woody vegetation which often includes bald cypress (Taxodium distichum), tupelo gum (Nyssa aquatica), pumpkin ash (Fraxinus tomentosa), swamp cottonwood (Populus heterophylla), and water locust (Gleditsia aquatica).

The surface of the water of these oxbows usually has several species of duckweed (including species of Lemna, Spirodela, Wolffia, and Wolffiella) and mosquito fern (Azolla mexicana).

Other characteristic herbaceous plants of these southern oxbows include sponge plant (Limnobium spongia), pond lotus (Nuphar advena), arrow arum (Peltandra virginica), pickerel-weed (Pontederia cordata), arrowhead (Sagittaria latifolia), and many others.

Both buttonbush (Cephalanthus occidentalis) and swamp rose (Rosa palustris) dominate the shrub layer in these communities.

Most of the other lakes and the ponds which occur in the floodplains do not have such a distinctive Coastal Plain element as do the southern oxbow lakes.

These other lakes and ponds frequently have "blooms" of duckweed. Various naiads (Najas spp.), the horned pondweed (Zannichellia palustris), pondweeds (Potomogeton spp.), and coontail (Ceratophyllum demersum) are sometimes found in the water.

Several shoreline herbs are characteristic. Among the most frequently encountered ones are rushes (Juncus spp.), ammannia (Ammannia coccinea), rotala (Rotala ramosior), yellow water cress (Rorippa sessiliflora), lindernia (Lindernia dubia and L. anagallidea), and rough buttonweed (Diodia teres).

The isolated nature of the lakes and ponds means that they are not subject to increased wave action. Those lakes and ponds in the protected floodplain are also generally immune from any activities along the major rivers. Very low-lying ponds and lakes in the unprotected floodplain could be damaged or destroyed by a major increase in channel depth in the major rivers, since water levels in them seem to fluctuate with the level of the main river channel.

Summary: Lakes and ponds of various origins occur in the protected and unprotected floodplains of the Mississippi and Illinois Rivers. Oxbow lakes in the southern tip of Illinois have a distinct Coastal Plain flora. Other lakes and ponds in the study area lack this Coastal Plain element, for the most part. Except for the most low-lying lakes and ponds in the unprotected floodplain, most lakes and ponds will not be affected by activities on the rivers.

## Marshes and Sloughs Communities

Included in this section are those low-lying expanses of land which generally have areas of standing water for various lengths of time during a year and which have a paucity of tree forms. They may be found along the Mississippi and Illinois Rivers throughout the entire length of the study area.

Most of these areas are densely covered with coarse grasses, sedges, and rushes. Of common occurrence are rice cutgrass (Leersia oryzoides), barnyard grass (Echinochloa pungens), various species of bulrushes (Scirpus spp.), cyperus (Cyperus spp.), and rushes (Juncus spp.).

Several different species of smartweed (Polygonum spp.) occur in the marshes and sloughs, as do many members of the aster family--goldenrods (Solidago spp.), asters (Aster spp.), snakeroot (Eupatorium spp.), and beggar's-lice (Bidens spp.).

In areas of the marshes and sloughs where water stands for most of the year, lotus (Nelumbo lutea) may occur in dense colonies.

Most of the marshes and sloughs in the floodplain have low, often temporary water levels which fluctuate with the level of the river channel. Any increase in pool levels adjacent to these communities will probably cause a change in species composition, although where changes will occur cannot be predicted at this time.

Summary: Marshes and sloughs occur the entire length of the study area. They are dominated by coarse grasses, sedges, and rushes. Extensive colonies of water lotus may develop where water stands for

much of the year. Increased pool levels will affect those marshes and sloughs adjacent to the rivers.

## Rivers and Streams Communities

This section is devoted to the waters of the rivers and streams and not to the shorelines which are discussed elsewhere in this report.

Because of the relatively fast-flowing water in the Mississippi and Illinois Rivers, there are few if any species of vascular plants which occur in the water of these rivers. Those species that rarely may be found are of a temporary nature and soon will be washed elsewhere.

## Old Field Communities

Floodplain areas which were at one time in cultivation begin an old field secondary successional pattern when cultivation ceases.

These Old Field Communities occur along the entire length of the Mississippi and Illinois Rivers. They exist in many different stages of succession, and exist in size from less than one acre to several hundred acres.

There is great diversity in the vegetation of the Old Field Community. Most of these are herbs, but woody plants begin to develop within a few years.

Klein, et al. (1974) report that the herb cover in the Old Field Community is usually at least 75%. Throughout the floodplain, the most common species are cockleburs (Xanthium spp.), docks (Rumex spp.), and ragweeds (Ambrosia spp.). Other very common plants are nut rush (Cyperus esculentus), timothy (Phleum pratense), sium (Sium suave), swamp milkweed (Asclepias incarnata), smartweeds (Polygonum punctatum, P. pennsylvanicum, P. lapathifolium, P. persicaria), morning-glories (Ipomoea spp.), asters (Aster spp.), and goldenrods (Solidago spp.).

Woody plants which invade the Old Field Community include cottonwood (Populus deltoides), black willow (Salix nigra), white ash (Fraxinus americana), silver maple (Acer saccharinum), and eventually pecan (Carya illinoensis), particularly in the floodplain south of Adams County, Illinois.

Those Old Field Communities which are in the unprotected floodplain and in close proximity to the major rivers will be affected by

increased activity on these rivers. However, all the species of these old fields are common and often weedy and occur throughout the area covered by this report.

Summary: Old Field Communities occur along the entire length of the Mississippi and Illinois Rivers and develop principally after cultivation. Many herbs, most of them weedy, comprise most of the vegetation of the old fields. Although old fields in the unprotected floodplains may be affected by increased activity on the rivers, few if any unusual species of plants will be affected.

## Cultivated Field Communities

Several areas in the floodplains of the Mississippi and Illinois Rivers are being cultivated for economic purposes. Most of these are in the protected floodplain, but some are unprotected.

Corn and soybeans are the most prominent crops in the region covered by this study. Pumpkins are grown rather extensively in Jackson County. In Morgan County, along the Illinois River, watermelons and canteloupes are grown in the sandy floodplains.

Species of plants of a weedy nature often invade the croplands.

## Levee Community

Levees provide artificial habitats for plants throughout the entire floodplains of the Mississippi and Illinois Rivers. The levees range in height from one to several feet. They are found at varying distances from the Mississippi and Illinois Rivers. Some have roads atop them, others do not.

Many of the levees have been seeded purposely with fescue (Festuca elatior), awnless brome (Bromus inermis), and Kentucky bluegrass (Poa pratensis). The vegetation of other levees has developed without man's purposeful intervention.

The species composition of the levees is diverse, with most of the species being of a weedy nature.

Species encountered along the levees from throughout the study area include brome grasses (Bromus japonicus, B. commutatus, B. racemosus, B. tectorum), beadgrass (Paspalum ciliatifolium), purple top (Tridens flavus), ragweeds (Ambrosia trifida and A. artemisiifolia), fleabanes (Erigeron annuus and E. strigosus), mare's-tail (Erigeron canadensis), goldenrods (Solidago canadensis, S. nemoralis), milkweed (Asclepias syriaca), and many others.

On levees close to and paralleling the major rivers, there is a difference in vegetation between the river-side of the levee and the opposite side. The river-side has a less diverse vegetation, presumably because of wave action which prevents a number of species from becoming established.

Increased barge traffic resulting in increased wave action will continue to erode into the river-side of the levees. Since the species of vascular plants along the river-side of the levee are common and of a weedy nature, no rare and endangered species of plants are involved.

Summary: Levees are artificial habitats made up of grasses and essentially weedy herbs. The river-side of the levees is generally less populated with vascular plants than are the opposite sides. Increased wave action will continue to keep down the number of vascular plants which occur on the river-side of the levees.

## Revetment Community

Revetments, or rip-rap, have been constructed along much of the banks of the Mississippi River for protection of these banks. Much less rip-rapping has been done along the Illinois River because of the more stable nature of this river's banks.

The revetments are made by piling large rocks along the banks to create a steep slope up to 3 meters high or higher. In the crevices of the revetments are found various species of vascular plants.

Klein, et al. (1974) reported on five revetments along the Mississippi River and two "island" revetments in the Mississippi River. They found that the species composition on the "island" revetments is similar to that found on the tips of rapidly growing islands.

On the five bank revetments, Klein, et al. (1974) recorded fifty-five species of vascular plants, including fourteen kinds of trees and shrubs. Woody plants included black willow (Salix nigra), peach-leaved willow (S. amygdaloides), sandbar willow (S. interior), stiff willow (S. rigida), silver maple (Acer saccharinum), buttonbush (Cephalanthus occidentalis), false indigo (Amorpha fruticosa), and trumpet creeper (Campsis radicans). Commonly encountered herbaceous plants on the revetments include smartweed (Polygonum lapathifolium), crab grass (Digitaria sanguinalis), morning-glory (Ipomoea lacunosa), and dogbane (Apocynum cannabinum).

Because the revetments are subjected to wave action, any factors increasing wave action will obviously increase the effects on the vege-

tation of the revetments. Plants will probably be washed from their crevices when subjected to continuously increased wave action.

Summary: Revetments provide artificial habitats for plants along the banks of the Mississippi River. There are several species of vascular plants which grow in the crevices of the revetments. Increased wave action will probably wash some of the revetment plants from the crevices. None of the revetment plants is considered rare and endangered.

## Dredge Material Disposal Site Community

Materials deposited from dredging operations may be either underwater, may be found as small islands, or may be over-bank.

Dredging material which has recently been deposited is nearly lacking in vegetation. Most of the small islands formed by dredge spoilage are devoid of vegetation.

It is only on the over-bank dredge deposits that vegetation occurs, and then only scattered and sporadic.

Initially the vegetation consists of pony grass (Eragrostis hypnoides), eclipta (Eclipta alba), lindernia (Lindernia anagallidea), spurges (Chamaesyce spp.), and ammannia (Ammannia coccinea).

During the next few years, coarser herbs develop, such as nut grass (Cyperus esculentus), barnyard grass (Echinochloa pungens), pigweeds (Amaranthus spp.), smartweeds (Polygonum spp.), and yellow water cress (Rorippa sessiliflora).

Usually by the fifth year, black willow (Salix nigra) and cottonwood (Populus deltoides) have begun to come in.

Summary: The Dredge Material Disposal Site Community develops where dredge spoilage has been deposited. The vegetation on these sites is very sparse. Newly deposited material is nearly devoid of vegetation.

## Discussion of Probable Impacts

The following observations are made concerning possible impacts that will be sustained by plant communities along the Mississippi and Illinois Rivers as a result of the construction and operation of Locks and Dam No. 26.

### Construction of L & D 26 (Replacement).

Plant communities in the immediate vicinity of the construction site for L & D 26 (Replacement) will undoubtedly suffer irreparable damage. Anywhere that actual construction will occur, where access roads must be built, where building materials must be stored, will destroy or alter significantly the existing vegetation. Several communities will be affected, but none contains species of vascular plants known to be rare or endangered either in Illinois or Missouri.

### Increased Barge Traffic.

The construction of L & D 26 (Replacement) may result in an increase in barge traffic estimated at 3 or 4 times on the Illinois River and double on the Mississippi River. The increase in barge traffic may result in impacts caused by dredge spoil disposal, air pollution, building up and wearing down of sandbars, wave wash, higher or lower water levels in pools, interruption of food chains due to adverse impacts on aquatic organisms, increased ground water levels, indirect impacts associated with increased fuel consumption and other secondary impacts associated with increased economic activities, and increased

chances for accidents. These impacts are speculated upon in the following paragraphs.

Dredge Spoil Disposal. It is speculated that more tow boats on the rivers will cut down on the need for dredging since they will stir up sediments on the bottom and help keep the channel open. There is a possibility that private parties might construct docks in areas deep enough in front of the docks so that increased dredge spoilage may result, at least in the beginning. There will also be some dredge spoil disposal in the vicinity of L & D 26 (Replacement). Care should be taken to insure that the disposal site is situated where there would be the least amount of impact on existing vegetation.

Air Pollution. More tow boats will mean more air pollutant emissions. Since tow boats use diesel fuel, water traffic in general is an efficient user of energy. Few studies have been done on the effect of tow boat fuel pollutants on adjacent vegetation. My supposition is that there will be little adverse effect on the vegetation along the Mississippi and Illinois Rivers, since none is apparent with the current amount of barge traffic.

Building Up and Wearing Down of Sandbars. There should be little effect on the vegetation due to building up or wearing down of sandbars. Some vegetation will be washed away, but should develop on newly formed sandbars. I have observed water fluctuation on sandbars for ten years in an area near Grand Tower, Illinois. Although vegetation is

sometimes washed off of sandbars and flats by flooding and other causes, the same species have always reappeared in the vicinity.

Wave Wash. There will be increased wave action due to increased barge traffic. Where this increased wave action directly comes in contact with an area where plants exist, those plants will be subject to destruction by being washed from their habitat or by being intolerant of continuous wave washing. No rare or endangered species of vascular plants are expected to be threatened by increased wave action, although some common vegetation will likely be adversely affected. Since the material in levees is not as cohesive as the material comprising the natural banks, the levees will probably be more susceptible to wave wash. Particularly when water is up during spring floods, the water traffic may have to be stopped sooner and at a lower water level than now currently in practice.

Higher or Lower Water Levels in Pools. The two-mile stretch below Lock and Dam #26 will probably be inundated. Obviously the communities present today which will be permanently inundated will be destroyed. None of the communities in this region is unusual or contains any particularly rare species of vascular plants.

Food Chains. Shoreline vegetation which would be washed away by increased activity on the rivers may possibly cause interruption of the natural food chain. At present, from four to eight inches of silts and sands are deposited annually on areas adjacent to the river and on

islands in the river, covering the existing ground cover and existing organic duff. Increased turbidity in the river will affect the phytoplankton. The possible introduction of pollutants by increased turbidity may affect the shoreline vegetation.

Indirect Impacts. With greater capacity for barge traffic may come an increase along and near the river for the development and/or expansion of terminals, industries, roads, parking lots, etc. It is sufficient to say that anywhere these activities take place will result in destruction of the existing vegetation. It is anticipated that most construction of this type will center around existing concentrations of industries. At any site where new construction is proposed, study should be made to ascertain what rare and endangered species, if any, are present.

Increased Accidents. It is logical to assume that increased barge traffic increases the likelihood of more accidents in the rivers. The amount and types of spillage from these accidents and the effects it would have on adjacent vegetation cannot be predicted at this time.

## Recommended Studies to Evaluate the Impacts of L & D 26 (Replacement) on Vegetation

Several studies are suggested which would add to the knowledge of the vegetation and the impacts of L & D (Replacement) on the vegetation.

I. Vegetation Map of the Floodplain Adjacent to the Mississippi River between Cairo, Illinois, and St. Paul, Minnesota, and in the Floodplain of the Illinois River between Grafton, Illinois, and Chicago.

Objective: To prepare a vegetation map of the floodplains indicating the location of each kind of vegetation community.

Methodology. Use of remotely sensed, high altitude imagery (ERTS, U-2, RB-57, aerial photos) would be useful in outlining vegetational zones. Actual field reconnaissances must be taken throughout the entire study area to determine precisely the nature of each community.

II. Systematic Study of the Species of Vascular Plants of the Floodplains Adjacent to the Mississippi River between Cairo, Illinois, and St. Paul, Minnesota, and in the Floodplain of the Illinois River between Grafton, Illinois, and Chicago.

Objective: To make an annotated list based on systematic collections of every species of vascular plant by navigational pool and to document fully the habitat(s) for each species.

Methodology. Most lists of vascular plants from the floodplains have been compiled from the literature. No list based on actual field work specifically in the floodplain of the proposed study area has ever been made. Field collections will provide more detailed habitat information for each species.

III. Systematic Study of the Species of Non-vascular Plants of the Floodplains Adjacent to the Mississippi River between Cairo, Illinois, and St. Paul, Minnesota, and in the Floodplain of the Illinois River between Grafton, Illinois, and Chicago.

Objective: To make systematic collections of non-vascular plants and prepare an annotated list of those species which occur in the floodplain.

Methodology. This study should include collections of algae from all available habitats (oxbow lakes, ponds, marshes, lakes, streams, rivers, etc.). It should include collections of mosses, liverworts, and lichens wherever they are encountered in the floodplain. No attempts have ever been made to ascertain what species of non-vascular plants occur in the proposed study area, what habitats they are found in, and what their distribution and abundance are.

IV. Effect of Wave Wash on Shoreline Vegetation.

Objective: To study the effect of wave wash on plant communities subjected to wave action.

Methodology. Several types of plant communities which are subject to wave action should be designated and the existing vegetation accurately mapped. Detailed observations of each community will be made to determine the effect of wave wash on the vegetation. Data to be recorded include the degree of wave wash and the effect it has on the shoreline vegetation.

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